Menlo Park Notebook #11 [N-78-12-28]

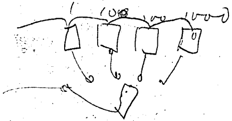
This notebook covers the period December 1878-June 1879. Most of the entries are by Francis Upton. There are also entries by Edison and Charles Batchelor. All of the material relates to experiments on electric lighting. Included are numerous notes, drawings, and calculations about generators; calculations relating to electric power distribution systems; and notes by Upton on "elements of uncertainty" in experiments and tests. The book contains 284 numbered pages.

Blank pages not filmed: 4-5, 48-81, 92-93, 186-187, 210-221, 242-245, 248-249.

X M0 11

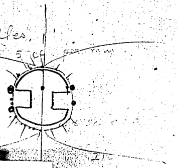
[illegible]

521,145


1
100
100
1000

5 feet per hour 60

75 candles


5 cf
per min
210

```
      60
candle 4500
        20
     90,000
        10
    900,000
        60
 54,000,000
```

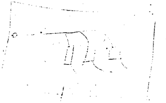
```
 1.4
  6
10.80
```

1120

```
  1120
    90
100,800
```

```
  ~~600~~
  1,120
  6,800
```

X MO 11



LIBRARY OF THE

BOARD OF PATENT CONTROL,

120 BROADWAY, NEW YORK.

Gen Library

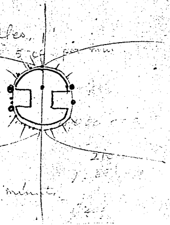
~~GENERAL ELECTRIC.~~

, 189

5 feet per hour 60

75 candles

60
4500
20
90,000
10
900,000
60
54,000,000



Cu foot 12 minutes

196
60
11760

1120
600
672,000

1120
90
100,800

1120
15
5600
1120
16,800

1120

45-1

ohms;

5000

$\frac{1}{62}$,

1	5
2	20
4	80
8	320

1

65,	330,	
66	340	1
67	350	2
68	360	3
69	370	4
70	380	5
71	390	6
2	400	7
3	410	8
4	420	9
5	430	10
6	440	11
7	450	12
8	460	13
9	471	14
80	482	

80)800($\frac{1}{4}$,

Gas, estimate cost of

10 000 — with 900 coke.

5, 2½ 5000.

1¼ — 10,000,

675

90

8,500

340.

5, .6 , 2500.

10,000.

1300, 10,000 [illegible]

1300 Coal gives 20000 [illegible]

1300 Coal " 650 hp 1 hour —

650

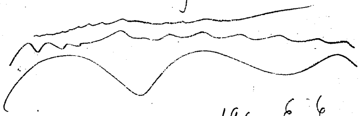
600

39,000

To Coke [illegible] 13 times more

13 more —

492400 (6



$$\frac{X^2}{265} \times 44.3 = 3300$$

$$X^2 = \frac{3300 \times 265}{44.3}$$

141

196
.7
197.2

3.5185
2.4232
8.3536
2 | 4.2953
2.1476
4.345176
137
2 | 4.345315
2.172657

172657
172603
14682
196) 54 08
08
21

6 6
4

@ 3
ε 4
R 8

4
265 ohm

3300

$$\frac{X^2}{265} \times 44.3 = 3300$$

$$X^2 = \sqrt{\frac{3300 \times 265}{44.3}}$$

22147
221.4

22
~~265~~
33

265
3300
79500

2214.7

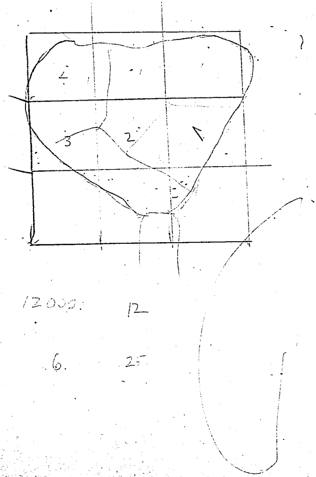
3 44.) 79500 (22
88
4
88
65
176302
340

148
148
1184
592
148
21904

6
3

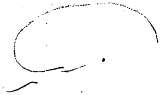
Size of gas burner

1380, 1 lb platina,
1380. deg

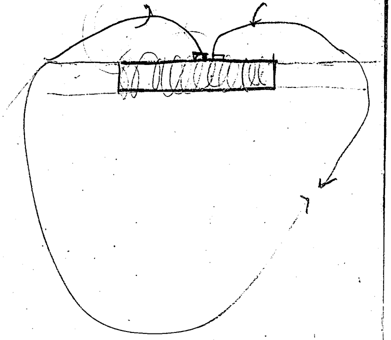


12000: 12

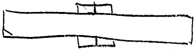
6. 25

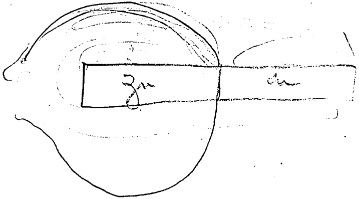


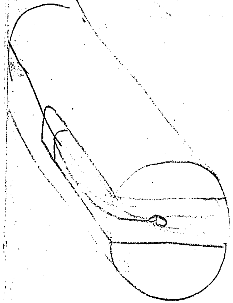
Non Commutator machine



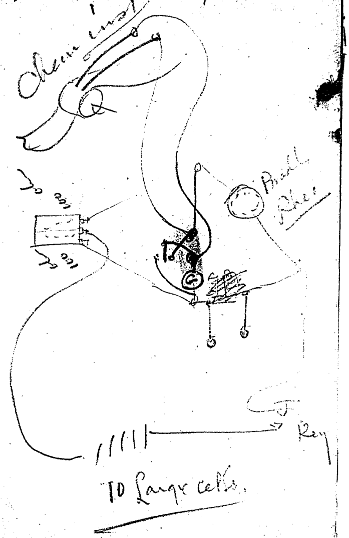
Line of force
like current in battery

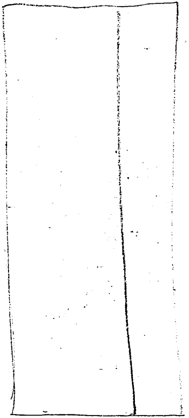






To show induction by automatic

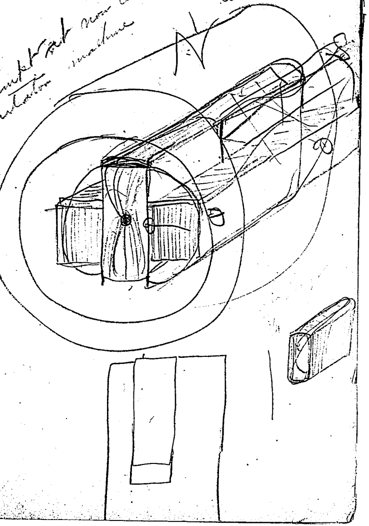

To 100
100 cl
Ball Plate
Key
TO Large cells.



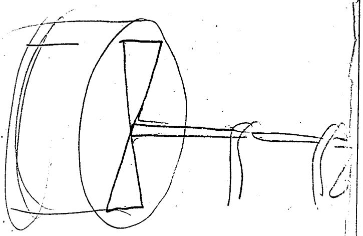
Dec 28 1878

Chas Batchelor

attempt at non commutator machine



Attempt at non commutator



141
141

141

141
141

141
4

3
6

148 3
148

1184 3
592
148

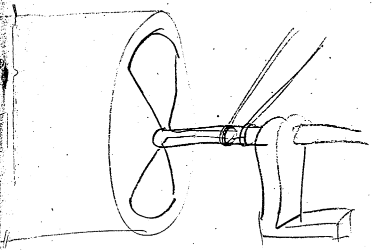
21904
44

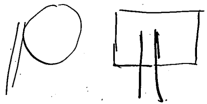
87616
87614

265) 98376 (37
1195 4

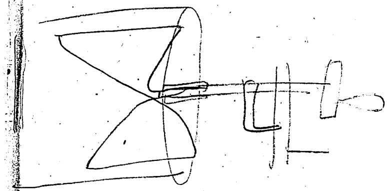
1687

Attempt at non commutator -

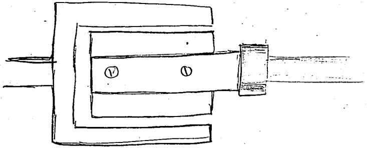




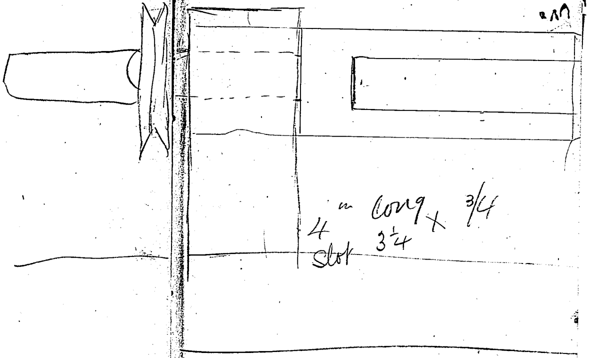
Attempt at non commutator



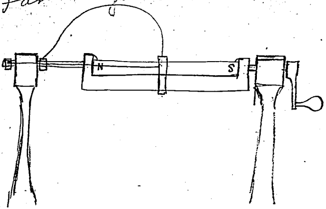
Attempt at non commutator.

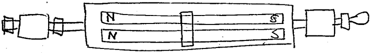


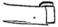
Attempt at non commutator

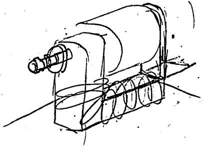

4" long × 3/4
slot 3¼

Faraday machine.









$$\frac{X^3}{265} \times 44.3 \doteq 3300$$

$$X = \sqrt{\frac{3300 \times 265}{44.3}}$$

265
3300
79500
79.5

44) 974500.0 (22147.
88
94
88
65
44
210
176
340
308
320

2
4
4
19.4
1.7
137.2

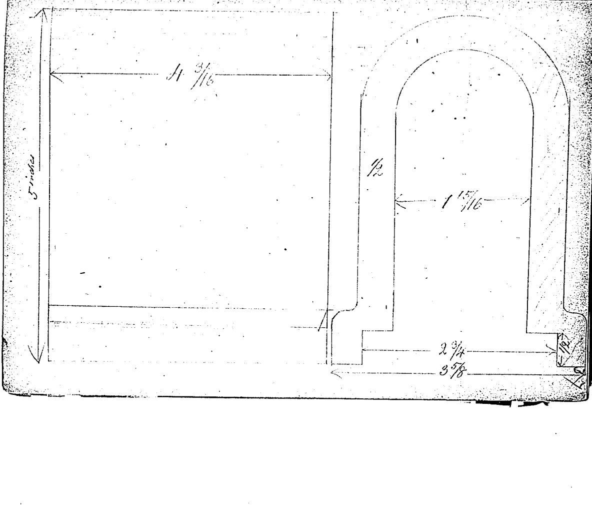
22147

4.345188
137
2 | 4.345315
2.172657

1000.

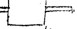
13) 120 (6
117
3

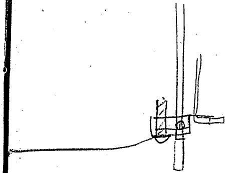
2
4
8

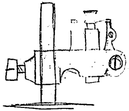

4 3/16
5 inches
1/2
1 15/16
2 3/4
3 5/8
1/2

Dimensions of the magnets machine —

Cores 2 feet [illegible] inches long
Cores 4 inches diameter

Armature made of
Shaft on which is wooden bobbin  on this is wound wire to the thickness on each side of an inch ① on this is fitted a shell (6½) six + half inches long to be wound like the other shell with 25 coils of 3 layers of wire that [illegible] designate





If $\frac{18}{16}$ of an inch of radiating surface per horsepower gives 15 Candle per $\frac{3}{16}$ radiating surface - ~~a~~ how many units of Energy will it require per $\frac{1}{16}$ -

33000 / 18

```
18 ) 33000 ( 1833
     18
     150
     144
       60
       54
        60
        54       .6
```

```
 1833.
    5
 9165.
```

5

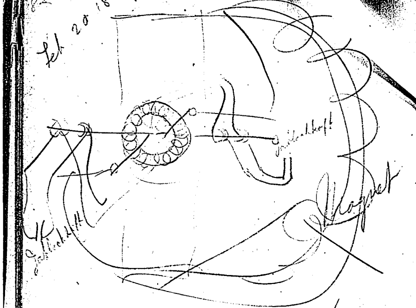
```
9165 ) 33000 ( 3
       27495
        5505.
```

25 - .16.

Machine $100
20 lamps
$5 $2000

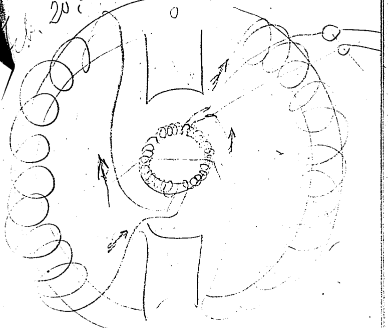
Pages 47 to ~~84~~ 81
omitted 4th Nov. 1879 J.R.M.

Feb 20 1879


Jablochkoff
Jablochkoff
Magnet

Split the ring and use for Jablochkoff & [illegible] commutator and for the field magnets.

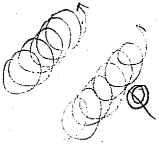
Feb 20 1879

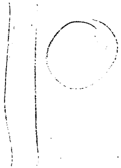


Winding Siemens 8

Feb. 20 1879

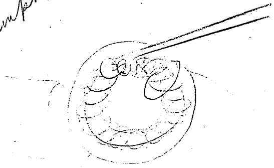
Attempt at non commutator



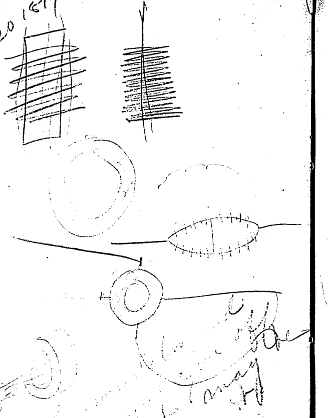


Feb. 20 1879.

Attempt at non commutator

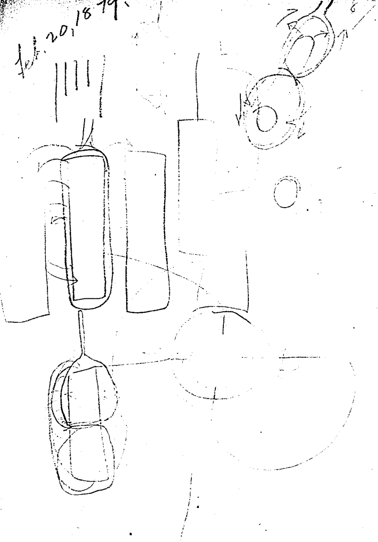


Feb 20 1879



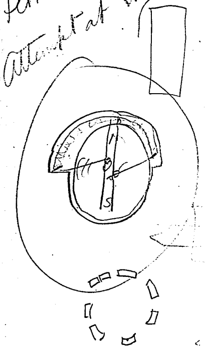
Now [illegible] [illegible] [illegible] make the [illegible] that I may take off any [illegible] [illegible] from the arrangement

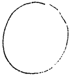
Feb. 20, 1879.



Feb. 20 1879

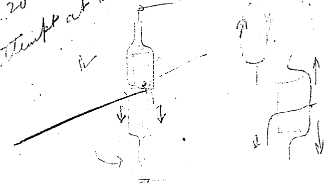
Attempt at non commutator

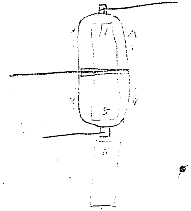


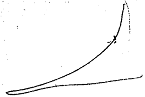


Feb. 20 1879

Attempt at non commutators

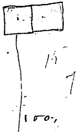






4 1/2

4/1



15

7 1/2 15

30

100. 100.

30

100

50 200. 36

15

180

36

540

100

200

35

100. 50 60

3 1/4

1/4 inch 100 units E. CP 15

1/4 " " 7 1/2

1/2 " 200 = 15.

1/2 200 = 30

1/4

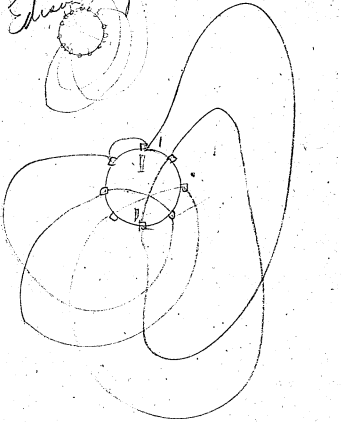
15

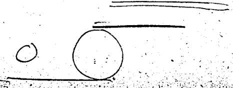
1. 1/16 1/[illegible]

1
2
4
8
16
32

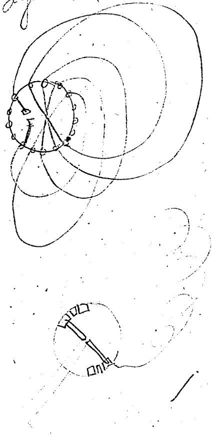
12
6
3
1 ½
.75
37 ½

Edison Dynamo

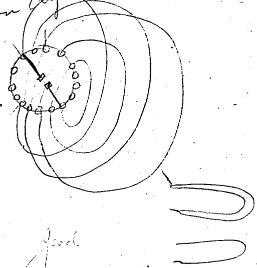




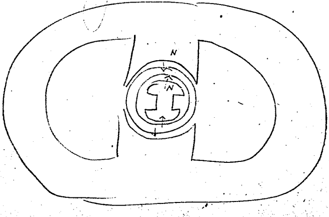
Edison dynamo



Edison dynamo

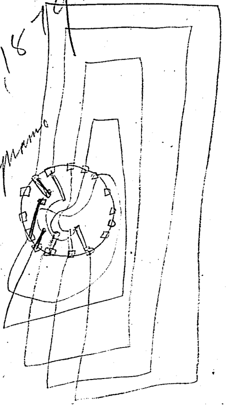


Good



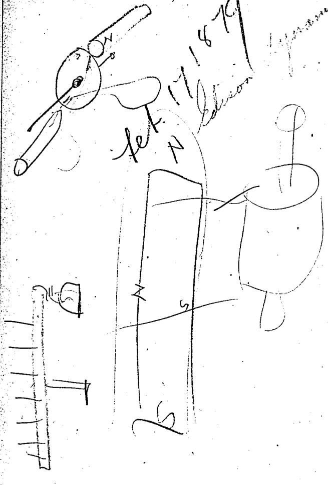
Feb 17 1879

Edison dynamo



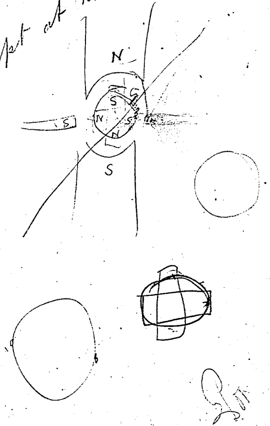
Feb. 17 1879

Edison dynamo



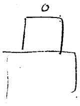
Feb. 17 1879

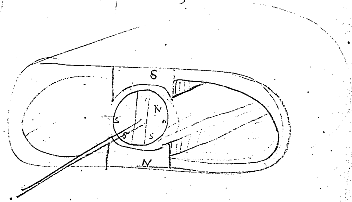
Attempt at new commutator

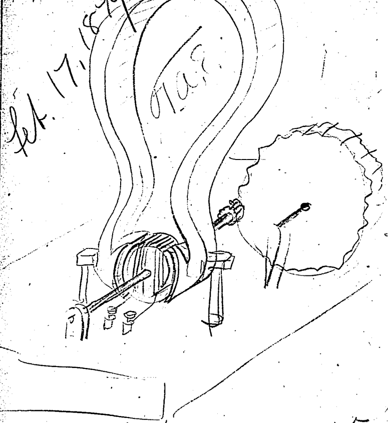


Feb. 17 1879

Attempt at non commutator



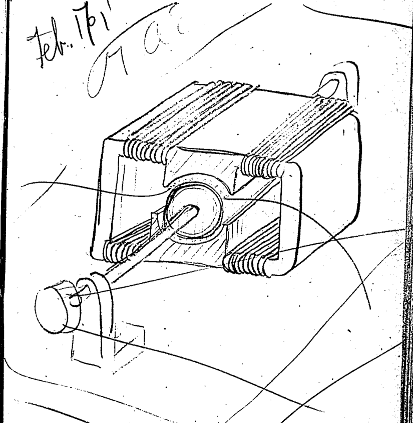




Feb. 17, 1879

TAE

attempt at non commutator

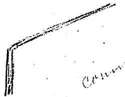


Feb. 17, 1879

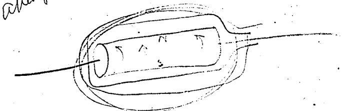
TAE

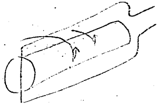
Attempt at non commutators

Did not work Feb. 20



attempt at non commutator





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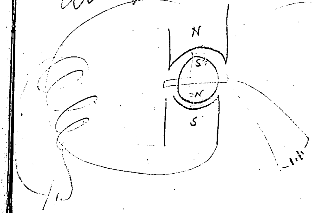
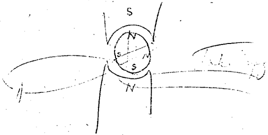
Attempt at non commutator





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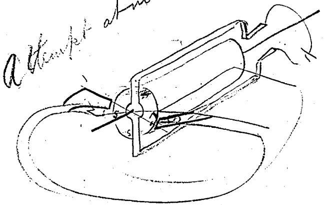

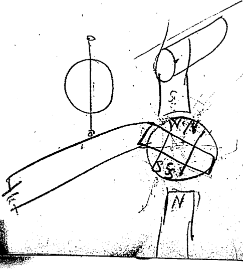

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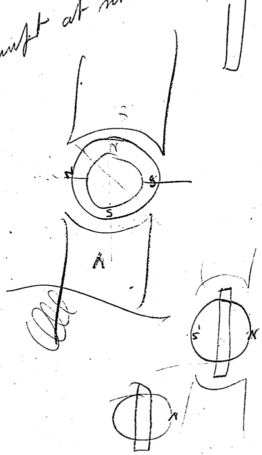
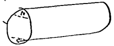
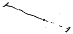






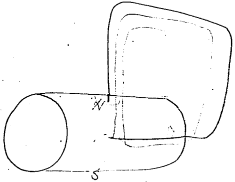
1 | 14 . inch red.

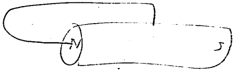
1 inch white. red

same current.

2 Pumps - 7

Faraday machine





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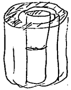

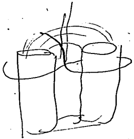

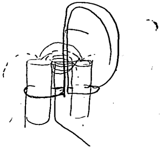

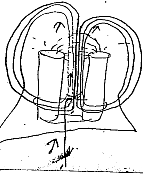

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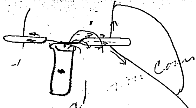

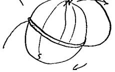

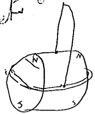

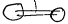

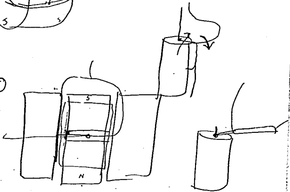

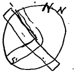

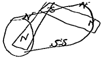

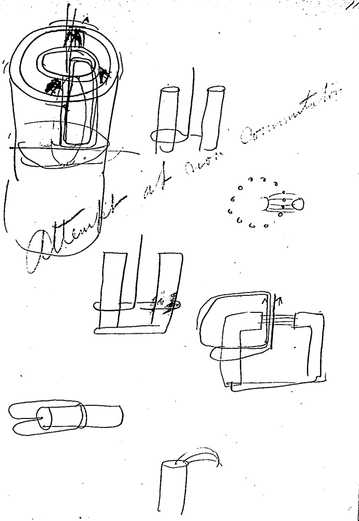

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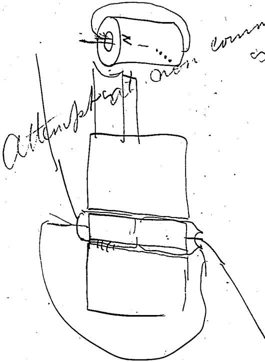

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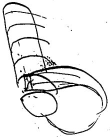

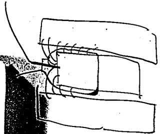

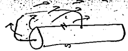

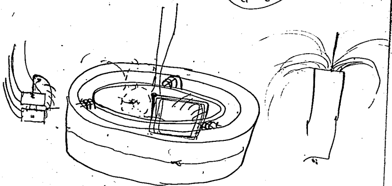

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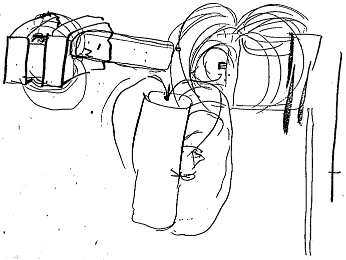
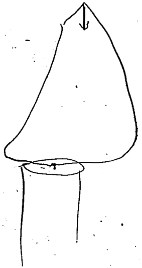
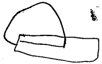
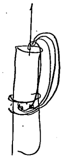
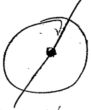
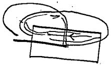




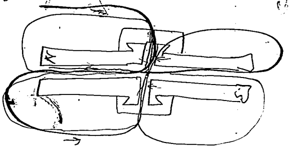


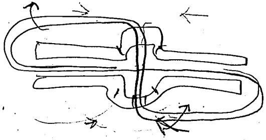




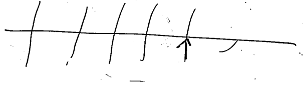


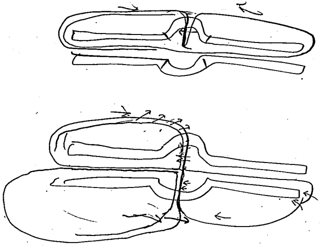
attempts at non commutator



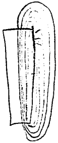


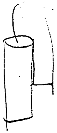
Attempts at non commutator

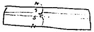


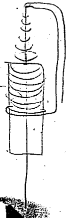


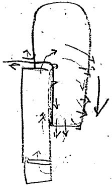
Attempts at non commutators











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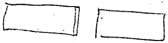

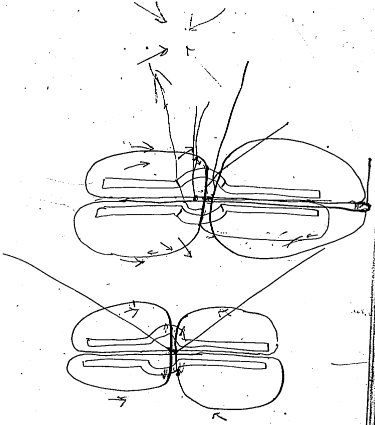

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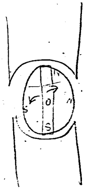

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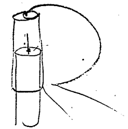

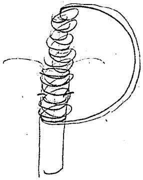

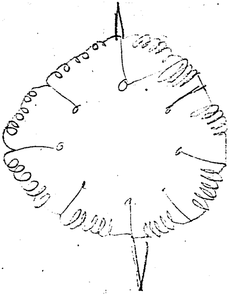

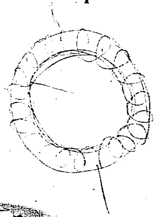

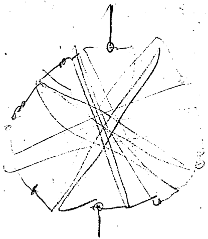

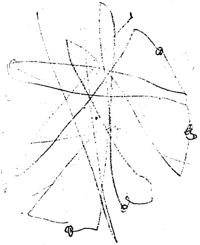

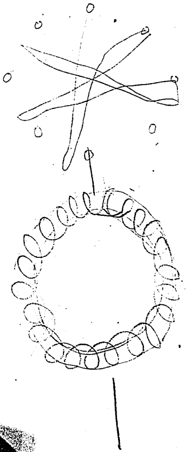

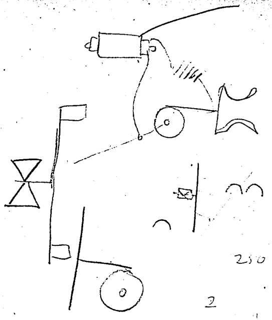

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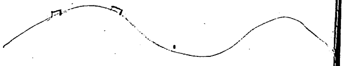

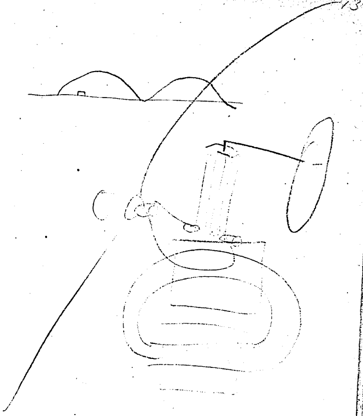

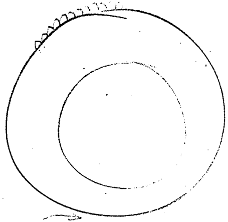

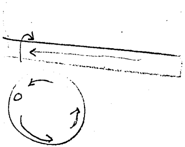

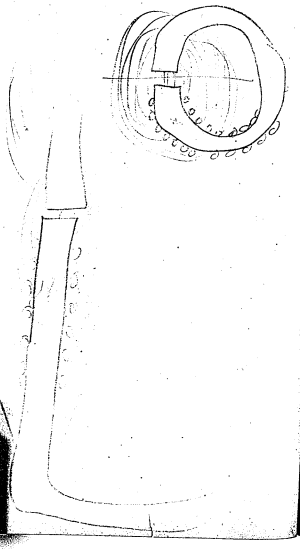

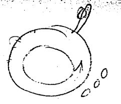

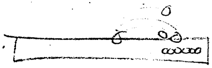

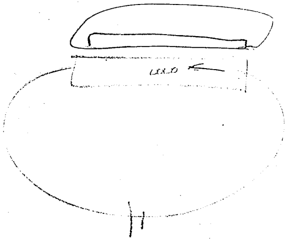

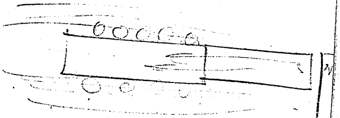

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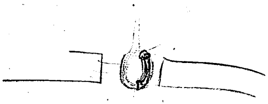

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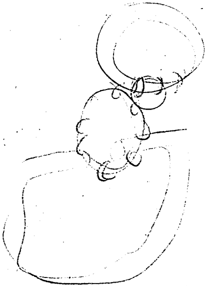

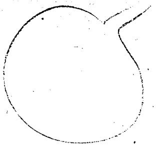

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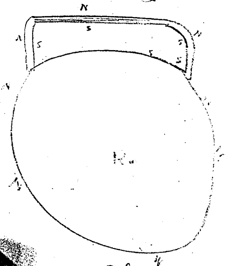
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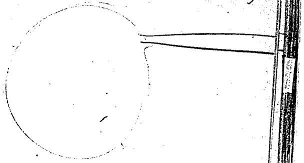
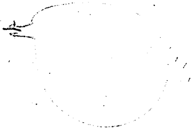
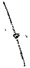
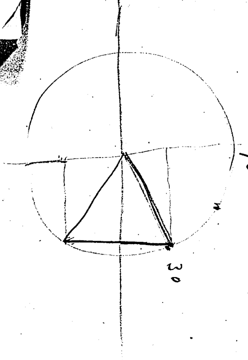
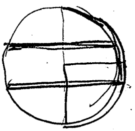










$\frac{3}{16}$ $\frac{12}{128}$ $\frac{13}{128}$ $\frac{14}{128}$ $\frac{15}{128}$ $\frac{16}{128}$ $\frac{17}{128}$ $\frac{18}{128}$

$12\overline{)13,}$ 1.093 $\frac{3}{16}$ $\frac{4}{16}$

$\frac{3}{16}$

1.33

6 $\overline{)33000}$

55000
1.15
27500
55
55
63 25.06

$3\overline{)5}$
1.666

1.288

7080

$$\begin{array}{r} .1096 \\ 3.7404 \\ \hline 3.8500 \end{array}$$

3|6 5500 3.7404
2 1.411 .1495
3.8899
7760.

3|7 3.7404
2.33 1.526 .1834
3.9238
8390

3|8 3.7404
2.66 1.63 .2122
3.9526
8450

3|9 3.7404
3 1.732 .2385
3.9789
9530

3|10 3.7404
333 1.824 .2611
4.0015
10.000

3|2 $\bar{1}$.8235 3.7404
.666 $\bar{1}$.9117 $\bar{1}$.9117
3.6521
4489

3.|1. (.5225 3.7404
.333 $\bar{1}$.7612 $\bar{1}$.7612
(.4771 3.5016
2385 2385
3174 3.7401

$\frac{1}{16}$ 3174

$\frac{2}{16}=\frac{1}{8}$ (4489
2244

$\frac{3}{16}$ 3(5500
1833

$\frac{4}{16}=\frac{1}{4}$ 4|6325
1581

$\frac{5}{16}$ 5|7080
1416

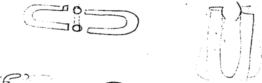
$\frac{6}{16}=\frac{3}{8}$ 6(7760
1293

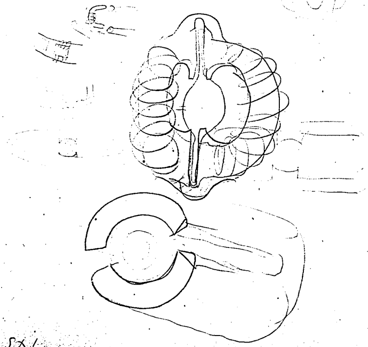
$\frac{7}{16}$ 7|8390
1198

$\frac{8}{16}=\frac{1}{2}$ 8|8950
1118

$\frac{9}{16}$ 19530

$\frac{10}{16}=\frac{5}{8}$ 10000





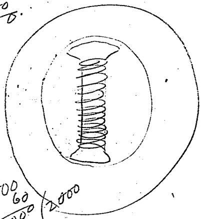
44
50
2200

1100
2200
330

15
7
105

7
60
420

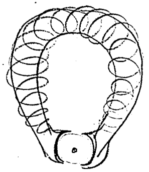
44
50
2200

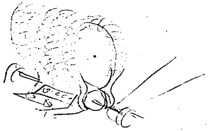


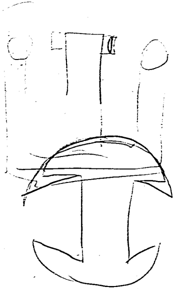
50
7
350

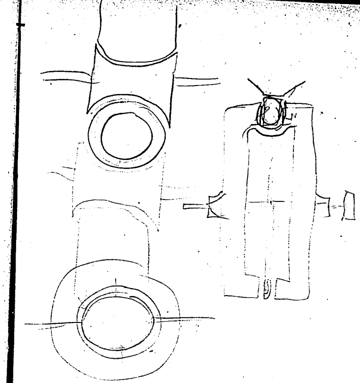
500
60
30.000 / 2000

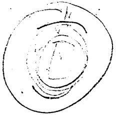
15 | 30.000
30

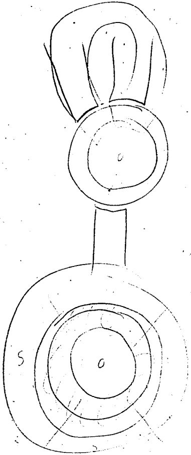


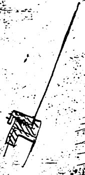


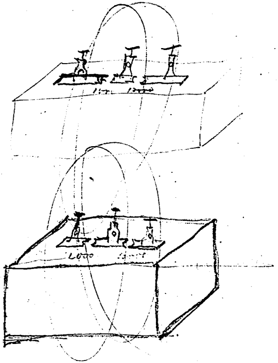




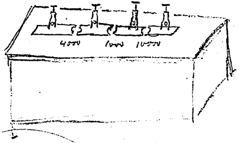


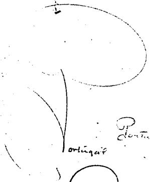

o
S
o





Pages 154 to 181."Sketches & Calculation."
(Unimportant)

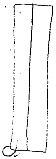

4000
1000
1000



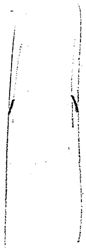
Portugais

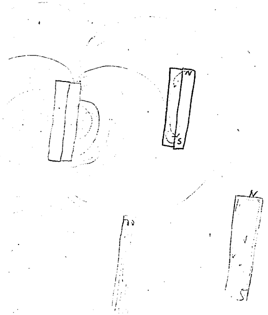
Portugal

Portland



Rowland




N
S
N
S

1 American Pittsburgh Pa.

$C = \frac{\mathcal{E}}{R}$ $W = c^2\left(R_B + \frac{R_L}{n}\right)$

C

$\mathcal{E} = 1$

$$W = c^2\left(R_B + \frac{R_L}{n}\right)$$

$$C = \frac{1}{R_B + \frac{R_L}{n}}$$

$c^2 R = \frac{\mathcal{E}^2}{R^2} R$

$W = \frac{\mathcal{E}^2}{R} = \mathcal{E}C$

$$W = \left(\frac{1}{R_B + \frac{R_L}{n}}\right)^2 \left(R_B + \frac{R_L}{n}\right)$$

$$= \frac{1}{R_B + \frac{R_L}{n}}$$

$$W \text{ in } B = \left(\frac{1}{R_B + \frac{R_L}{n}}\right)^2 R_B$$

$$W_{\text{in lamps}} = \frac{1}{R_B + \frac{R_\ell}{n}} - \frac{R_B}{\left(R_B + \frac{R_\ell}{n}\right)^2}$$

~~W~~ [illegible]

$$W_{n\ell} = \frac{\cancel{R_B - R_B} + \frac{R_\ell}{n}}{R_B^2 + \frac{2R_L + R_L}{n} + \left(\frac{R_L}{n}\right)^2}$$

$$\cancel{W_\ell} = \frac{R_\ell}{n^2 R_B + 2 R_B n + 2 R_\ell n + R_\ell^2}$$

$$= \frac{R_L}{R_B^2 (n^2 + 2n) + R_\ell (2n+1)}$$

$$R_B = 1$$

$C = \frac{\mathcal{E}}{R_{\mathcal{B}} + R_{\mathcal{L}}} = \frac{\mathcal{E}}{\mathcal{B}+\mathcal{L}}$ | $W = C^2(\mathcal{B}+\mathcal{L})$

$W = \left(\frac{\mathcal{E}}{\mathcal{B}+\mathcal{L}}\right)^2 \mathcal{B}+\mathcal{L} = \frac{\mathcal{E}^2}{\mathcal{B}+\mathcal{L}}$

$W_{\mathcal{B}} = C^2\mathcal{B} = \frac{\mathcal{E}^2}{(\mathcal{B}+\mathcal{L})^2}\mathcal{B}$

One lamp

$W_{\mathcal{L}} = C^2\mathcal{L} = \frac{\mathcal{E}}{(\mathcal{B}+\mathcal{L})^2}\mathcal{L}$

~~$\frac{W_{\mathcal{L}}}{n} = \frac{\mathcal{E}^2}{(\mathcal{B}+\mathcal{L})^2}\frac{\mathcal{L}}{n}$ $\mathcal{E}=1$ $\frac{1}{(\mathcal{B}+\mathcal{L})^2}\frac{\mathcal{L}}{n}$~~

n lamps $\frac{\mathcal{L}}{n}$ = resistance

$C = \frac{\mathcal{E}}{\mathcal{B}+\frac{\mathcal{L}}{n}}$

$W_{\mathcal{L}} = C^2\frac{\mathcal{L}}{n} =$

$W_{\mathcal{L}} = \frac{\mathcal{E}^2}{(\mathcal{B}+\frac{\mathcal{L}}{n})^2}\frac{\mathcal{L}}{n}$

~~$\mathcal{L}$~~ $\mathcal{E}\,C$

$\mathcal{E} = CR$

$W = C^2R$

$W = \mathcal{E}C$

~~$W = \left(\frac{\mathcal{E}}{\mathcal{B}+\frac{\mathcal{L}}{n}}\right)^2$~~

$C^2 = \frac{\mathcal{E}^2\frac{\mathcal{L}}{n}}{C\frac{\mathcal{L}}{n}}$

$W =$

$C = \frac{\mathcal{E}}{\mathcal{B}+\frac{\mathcal{L}}{n}}$

$C = \frac{\mathcal{E}^2 n^2}{\mathcal{L}^2}$

$W = \frac{\mathcal{E}^2 n^2}{\mathcal{L}^2}\frac{\mathcal{L}}{n} = \frac{\mathcal{E}^2 n}{\frac{\mathcal{L}}{n}} = \frac{n\mathcal{E}^2}{\mathcal{L}}$

$\frac{W}{n} = \frac{\mathcal{E}^2}{\mathcal{L}}$

$C = \frac{\mathcal{E}}{\mathcal{L}}$; $W = C\mathcal{L}$

$C^2 = \frac{\mathcal{E}^2}{\mathcal{L}^2}$

$W = \frac{\mathcal{E}^2}{\mathcal{L}^2}\mathcal{L} = \frac{\mathcal{E}^2}{\mathcal{L}}$

$C = \frac{\mathcal{E}}{\mathcal{B}+\frac{\mathcal{L}}{n}}$

$C = \frac{\mathcal{E}}{\mathcal{B}+\frac{\mathcal{L}}{n}}$

$W = C^2\frac{\mathcal{L}}{n}$

$W = C^2\frac{\mathcal{L}}{n} = \frac{\mathcal{E}^2}{(\mathcal{B}+\frac{\mathcal{L}}{n})^2}\frac{\mathcal{L}}{n}$

$\mathcal{L} = 2$ $n = 2$

$\mathcal{B} = 1$

$\mathcal{L} = 2$ $n = 1$

$\left(\frac{1}{9}\right) 2 = \frac{2}{9}$

$\frac{1}{\ }$

50 Ohms in lamps

1 Ohm in machine &c

$\mathcal{E} = 1$

$n = 1$

$$\frac{50}{(51\cancel{0})^2} \quad \frac{50}{(510)^2} = H \quad \frac{\cancel{(5)^2}}{\cancel{R}}$$

$$\frac{\frac{50}{2}}{1+}$$

$$\begin{array}{r} 1.70757 \\ 1.70757 \\ \hline 3.41514 \end{array}$$

$$\begin{array}{r} 1.69897 \\ 3.41514 \\ \hline \bar{2}.28383 \end{array}$$

.0192

$$\frac{50}{2}$$

$26\,)\,180\,($

---

1 Ohm outside 1 cell

~~.11 Ohm internal~~

.11 Ohm internal

$\mathcal{E} = 2$ Daniells = 2 Volts

$C = \frac{\mathcal{E}}{R} = \frac{2}{1.11} =$ (Webers &

W ~~ork~~ $= C^2 R = \left(\frac{2}{1.11}\right)^2 1.11 \times 44.2$

$=$ ~~foot~~ lbs.

$\frac{4}{1.11} \times 44.2 =$ about

Total 160 ft. lbs.

2 cells $C = \frac{\mathcal{E}}{R} = \frac{4}{1.22}$

$\mathcal{E} = 4$

$R = 1 + .22^2 = 122$

$W = C^2 R = \left(\frac{4}{1.22}\right)^2 (1.22)$ ~~14.0~~

$W = \frac{\mathcal{E}^2}{R} = \frac{16}{1.22}$ 44.2

1.20412
9.91364 - 10
1.64542
2.76318

579. ft lbs

log. 33.000 4.51851
2.76318
1.75533

56. to H.P.

---

3 cells $\mathcal{E} = 6$ Volts

$R = 1.33$

log 36 1.55630
1.33 9.87615
44.2 1.64542
~~X~~3.07787

1196

---

4 cells $\mathcal{E} = 8$

~~400~~
~~1600~~
~~1.64~~
.36.9

~~1.23~~
~~11.~~
~~44.2~~

400
~~1600~~
~~6400~~
~~144~~
~~36~~
8

1.23
400
492.00

4.9
~~44.2~~

4.9
400
1960.00

5 cells ~~[illegible]~~

$\mathcal{E} = 10$

500

~~2500~~ | 44.2

$W = \frac{\mathcal{E}^2}{R}$

~~1155~~

31

$31\overline{)44.2}$ 1.42

31

132

124

80

1.42

500

710 000

6 cells

3

2000

~~10000~~

44.2

~~1055~~

31

$31\overline{)44.2}$ 1.42

1.42

2000

2840

284 000

1 cell	160 ft lbs
2 cells	579
3 cells	1169
4 cells	1960
5 cells	2840
	1960
	880

March 12

The whole science of Nat. Phil should be expressed in Energy. A good way to express the would be with initial letters as H.E Heat E.E. Electrical energy be

$\mathcal{E}$

250 2.39794
862 2.93551
5.33345

215500.

250
4 | 862000
215500

16 30

2000
125
25
215000

86
25
430
172
21550

250
862
1/4
21 1/44

21

250
862
2 1/2
1724
431
215500

250
862
104
312
416
2 | 44824
22402

1600
400.

13
3313
15[illegible]

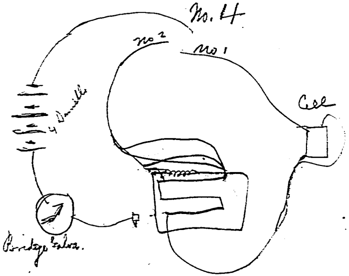
836.481
831458

6688.848

64.00000.

836.481
831468

6691848
2509443
836481
3345924


No. 4
no 2
no 1
Cell
4 Daniells
Porridge Galv.

$b_1 = 1360$

$a_1 = 1010$

$b_2 = 2960$

$a_2 =$ ~~950~~ 2010

```
    2010
    1360
 -------
  120600
   6030
  2010
 -------
 2733600
```

```
     1360
     2960
  -------
    81600
   12240
  2720
  -------
  4025600
```

```
        27
4025600 - ~~1292000~~
```

~~950~~ — 1010 (95)

```
2010 — 1010
1010
----
1000
```

```
1360
~~950~~
```

```
      950
     1360
   ------
    57000
    2850
    950
   -------
   1292000
```

```
4025600
1292000
-------
2733600
```

1000)

```
        4025600
        2733600
       --------
1000)  1292.000
       --------
        1292
```

$$\begin{array}{r} 1010 \\ 2960 \\ \hline 60600 \\ 9090 \\ 2022 \\ \hline 2989600 \end{array}$$

$$\frac{2989600 - 2733600}{2010 - 1010}$$

$$\begin{array}{r} 2010 \\ 1360 \\ \hline 120600 \\ 6030 \\ 2010 \\ \hline 2733600 \end{array}$$

$$\begin{array}{r} 2989600 \\ 2733600 \\ \hline 256000 \end{array}$$

$$\begin{array}{r} 2010 \\ 1010 \\ \hline 1000 \end{array}$$

$$\begin{array}{l} 1000)\ 256000\ (25 \\ 2000 \\ \hline 5600 \\ 5000 \\ \hline 6000 \\ 6000 \end{array}$$

How do y 13.000

How do you get that now?,

$13.000

$13.000 $13.000

13.000 $13.000

How do 13. you $13.000

$13000

Three $13.000 third $13.000 nice

$13,000 $13.000

$13.000 $3,000

$13.000

$13.000 $13.000

Three $13.000

$13.000 $13.000

How do you get that now? How do you get that now

Lawless

Lawless Lawless.

Lawson How do

Lawson

" Ray 100 for machine

5 1.30

~~gas 1/2 ct 3 per hour~~ 1.30

~~gas 1/2 13 ct per hour~~

1.30

$13.00

$1.30 .1139

365 2.5623

3.5516

3.5 mills

$.0035 3.5

~~How do you get~~

eg 1/2 cent

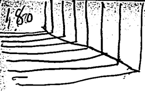
that now!

Lawless Lawless

Lawless

How do you get that

now?



A lamp at three cents
[illegible]

$2.00 per 1000

$\frac{200}{\cancel{1000}\ 200} \times 5$ = 1 ct. per hour
1 ct. per hour

$\frac{200}{200} \times$ ~~[illegible]~~ 1 ct. per hour

1 ct. per hour

1 cts. per hour Francis
Francis R. Upton
Franc is R.
Francis R. Upton
Francis R. Upton

Francis R. Upton

June 22 1879
June 22 1879
June 22 1879.

June22 June22 June June
June22 June22 June 22
June 22 June22 June June 22

The elements of uncertainty
are the following

1st Change in the brain
of the operator especially in his
memory. You bet old boy

2nd Change in the solutions
in the standard cells. If
the saturation of the Zn. solution is
less there is for a small change
1% difference. Between standard
cells and and ordinary Daniells
there is a difference of 3%

3rd Change in the high resistance
galvanometer, this seems to be
the hardest to control for outside
current get into the line seemingly
without cause, probably thermo
currents. Then if some one
with a knife happens to stand

near the galvanometer a
deflection is obtained.
Then a slight lack of proportion
ality in the divisions.

4th Changes in the dynamometer.
Jar affects the zero point
Then rusting of the points seems
to ~~[illegible]~~ make friction by holding
dust, Perhaps an error enters
into this instruments, by the change
a capillarity of the mercury, so
that for strong currents a slight
constant error is introduced.
Besides this errors due to torsion
of the wire irregularities

5th Change in the resistances from cooling. I have not been able to measure the magnet until two or three minutes after the current has ceased as the discharges is so great.

6 Change in the commutators I have not been able to make any allowance for this and propose to place the dynamometer in the machine shop so that I can watch the spark

7 Change in the speed of the engine this varies when running so light 5%.

Slipping of Belts

Francis R. Upton

---

pm Grosvenor P. Lowrey

1

60465
4
241860
4
96744
4
386944
4
1,547,776

1.547.776

96.744
96744

5280

12093
2
24186
2
48372
2
96744

6046.5

96.744
96.744
96.744
96.744

96.744
96.744
96.744
96.744
96.744

6046.5
4
24186.0
4
~~[illegible]~~
96744

log 96.744
5280

4.98563
3.72263
1.26300
2~~9~~3
~~75~~
7

18.3223
4
73.2922
4
293.1688

4)6046.5
1511.625
9
13604.6
4
54418.4
4
217673.6

217673.6

33766
15
5.33781
3.72263
1.61518

41.227
4
164.908
4
579.6324
231.81528

13604.6
9
122441.4

217673.6
5280
~~[illegible]~~
41.22

5.33781
3.72263
1.61518

25

1511.62.5

37790.625
4

1511625
4

6046500.0

5.78151
3.72263
2.05888

114.52
4
466.08
4
1864.32

37790.625
9
340115.625

5.53163
3.72263
1.80900

64,4,1

1511.625

1511.625
4.9

74060.8

log 4.

amp log 5280

~~503.089~~

3.17944
1.69020
~~4~~.86964
~~5~~
0.60206
6.27737 −10
1.74907

56.1139
4
244.4556.

1511625
1511625
1662787 5
1511625
1677963.7 5

64.1
56.1

8

73.3
64.1
9.2

1.2

9.2

56.1
6.8
49.3
5.6
43.7

6.8
1.2
5.6

13
13
39
13
169

Comp 5280

1511.625

3.17944
2.22789
6.27737 — T
11.68470
1.68470

48384

7.2
7.7
8.
9.2
9.4
17
17

3.17944
6.27737
9.45681

T.45681
1.23045
1.23045
1.91771

~~4 (6046,5~~

[illegible]

~~1511.625~~

~~152~~

4 (6046,5

1511.625

4 (763257865421783

4 (190814466355460

4 (477036165588865

4 (11925904147215

4 (2981476036803

4 (740369009201

4 (185092502301

46273125575

4

185092502300

4

740370009200

4

1480036800

4 (635944442495654682474

4 (15898610623913670368

4 (3974652655978417592

4 (993663163994604393

4 (248415790998651098

4 (62103947749662774

4 (15525986937415693

4 (3881496734353923 +

970374183582230

4

7 mistakes

3881496734328920

4

15525986937415680

4

62103947749662720

4

+ 248415790998650880

4

+ 993663163994603520

3974652655978414080

4

X 15898610623913656320

4

X [illegible]37944442495654625280

4 (544901890749923781998416

4 (136225472687480945499604

4 (34056368171870236374901

4 (8514092042967559093750

4 (2138523010741889773482

4 (532130752685472443371

4 (133032688171368110843

4 (33258172042842027711

4 (8314543010710506928

X 2078635752677626732

108
55

4

8314543010610506928

4

X 33258172042842027712

4

133032688171368110848

4

532130752685472443392

4

X 2128523010741889773568

4

8514092042967559094272

4

134056368171870236377088

4

136225472687480945508352

4

544901890749923782033408

778035469653542101167
4
3112141878614168404668
4
72448567514456673618672
4
49794270057826594474688
4
199177080231306377898752
4
796706320925225511595008
4
3186833283700902046380032
4
12747333134803604185520128
4
4 50989332539214432742080512
4 12747333134803608185520128
4 3186833283700902046380032
X X X
796708320925225511595008
199177680231306377898752
49794270057826594474688
124485675144566488618672
3112141878614137154668
7780354696535342888667

11 6558.1
81.4

54418.4
4

5280) 217673.6 (41.22
21120
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10560
13700
10560
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5280

~~75584~~
7558.1
10581.4 3033.3
13604.6 3023.2
16627.8 3023.2
19651.6 3023.8
22684.0 3023.4
25697.4 3023.4
28721.1 3023.7
~~286479~~
30744.1 30230

1
4 3 2
9 5 2
16 7 2
25 9 2
36 11 2
49 13

1511625
164
6046500
9069750
9674400 0

1511.625
49
13604625
6046500
74069625

1511.625
81
1511625
1209.3000
122441.625

96744.0
74069.0
22674 4

11/6

60465
1511.625
1511625
1511625
16779037 5

11

1511625
36
9069750
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1511.625
.121
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1511625
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1511625
1511625

121 0
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3023250
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182906.625

13/8

1511.625
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13
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39
13
169

182906.6
151162.5
31743.1
3023.4
5. 00000
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1

log 1511.625 3.17944
comp ~~6280~~ 5280. 6.27737
945681
$\bar{1}$.45681
+
= × ÷ 144 2.15836
41.22 1.61517 7.16

$\bar{1}$.45681
13 1.11394
13 1.11394
= 48.38 1.68469

$\bar{1}$.45681
14 1.14613 8
1.14613
56.11 1.74907 7.73
59

$\bar{1}$.45681
6445 1.17609 8.30
5611 1.17609 57
830 1.80899 ~~683~~
~~6294~~
~~5611~~
683

$\bar{1}$.45681
16 1.20412
1.20412
73.29 1.86505 53
~~6294~~
~~1035~~
.7329
.6441
888 8.88

$\bar{1}$.45681
17 1.23045
1.23045 84.67
73.29
~~84.67~~ 1.92771 11.38 ~~1038~~ 57
8274
7329
945 945

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18 1.25527 .55
1.25527 ~~945~~
9275
8274
1001 1.96735

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19 1.27875
1.27875
103.2 2.01431

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1.30103
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22
135.4 2.13165

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1.38021
24 1.38021
164.9 2.21723

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28 1.44716
1.44716
235113

[illegible]

2245

561
4
2244

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32 1.50515
1.50515
2.46711

293.1

2931
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26379

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114.6
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48 1.68124
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2.81929

164.9
4
6596

659.6
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3.26299

1833
~~1848~~

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96 1.98227
1.98227
3.42135

2636

1965

1389 3.14270
1389 3.14270
6,28540
4 ,66206
5,68334 .4823

13
.13
39
.13
169

.81 ,9
,64 ,8
,49 .7
,36 .6
694 ~~0000~~ 125 ,5
116 ,4
,09 .3

1000000
482300

1965

982.5
961,5
9
924.5
907.

13

E. M. F

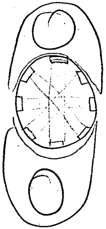
100 100 100 100
7

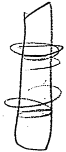
1.972 mg

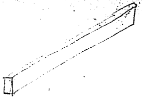
60) .001972 Grammes

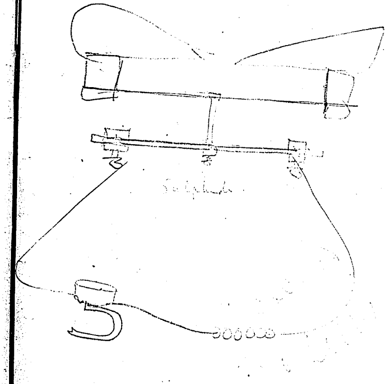
.0000328 second

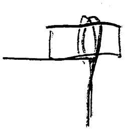
.0328

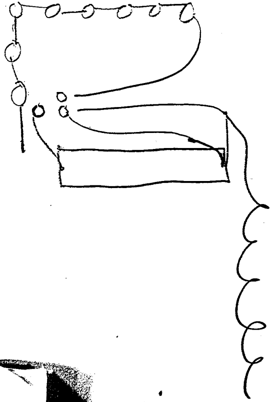







Sulphate





3900
1100
15000

69 1390

67 6 9 00
0.18 8390
1.098970

2088420

2

0000

6.129
1500

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1088420
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16
0
16 3

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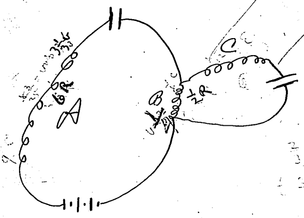
37.470



I make the deflection from 4 cells = 108 . 27 per cell

A = 6 Ohms around which I have an deflection of 83

27) 83 (3
81
2

I make the deflection around ½ A or 3 ohms = 300 then the deflection from around B was 49 C being opened.

~~I close C and~~

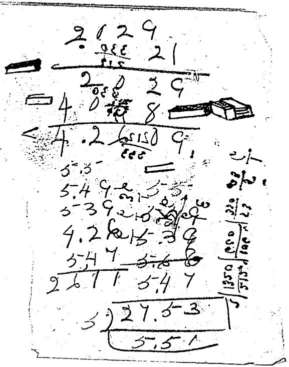
C open deflection around B made equal to 330

C closed deflection around B = 311

and around C = 212
6 Ohms

Required the current in Webers ~~around~~ through C

[ITEM FOUND IN BOOK]



2129

21

2029

4 0 [illegible] 8

4.2 [illegible] 9

5.5

5.49

5.39

4.2 [illegible] .39

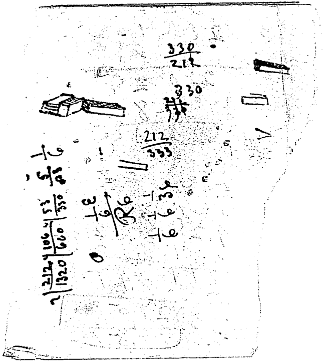
5.47 ~~5.68~~

2611 5.47

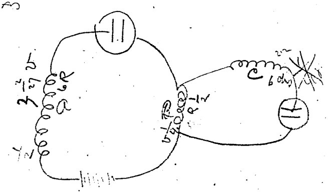
5)27.53

5.51

[ITEM FOUND IN BOOK]


330
212
330
212
333
2 | 2124 | 1320
106 | 660
53 | 330

$3\frac{1}{4}$ $\frac{13}{4}$ $6\frac{1}{2}$ $\frac{13}{2}$


5
$3\frac{2}{27}$
6R
a
$\frac{1}{2}$
C
6 ohms
R $\frac{1}{2}$
$\frac{1}{4}$

X = web.

$C = \frac{\mathcal{E}}{R}$ $\mathcal{E} = \frac{1}{2}$ $R = \frac{1}{2}$

$C = \frac{\mathcal{E}}{R}$

$C = \frac{1}{2}$

$\mathcal{E} = C R$

$R = \frac{1}{2}$

$\mathcal{E} = \frac{1}{4}$

$3 : X :: 300 : 49$

$\frac{49}{3}$ $\frac{147}{300}$ $2\ \frac{44}{3}$ $\frac{150}{500}$ $\frac{1}{2}$ 2

$\frac{1}{2}$

2

$27)83(3\frac{2}{27}$
81
2

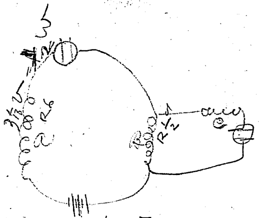
$\frac{1}{2} : X :: 330$

$\frac{1}{2}$

Let x = webers

$330 + 6X = 212 + \frac{1}{2}X$

$330 + 6x - 212$



$$\frac{V\,3}{R\,6} = \frac{1}{2}\,W$$

27)83(3 $\frac{2}{27}$ $\frac{1}{13}$
81
2

$\begin{array}{r} 49 \\ 3 \\ \hline 147 \end{array}$ 2

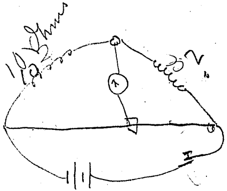
3 : x :: 300 : 49

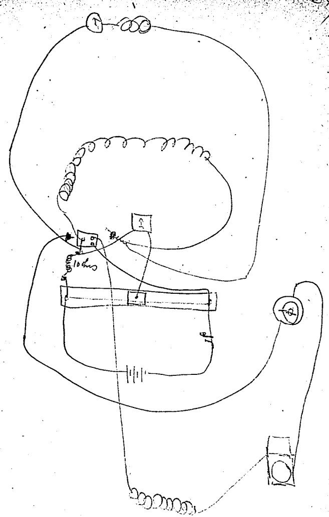
)147)300 (
300

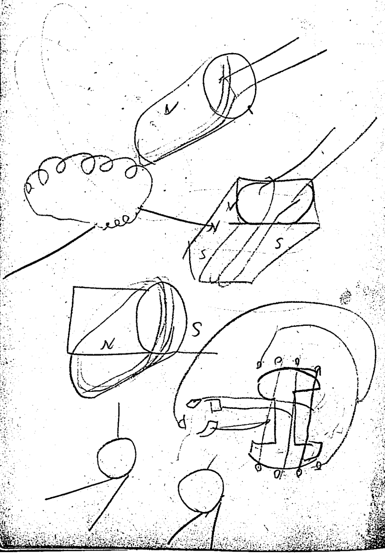
~~Let x [illegible]~~

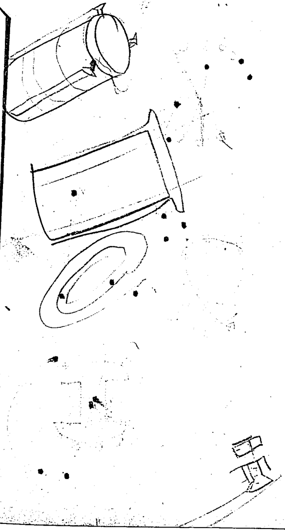
Let x = one weber of current

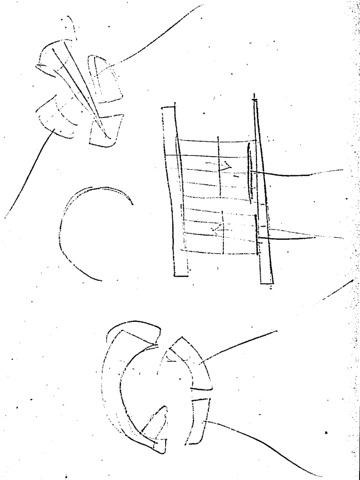
6X + ½

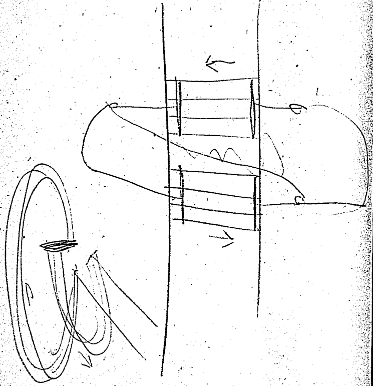

10 Ohms
2

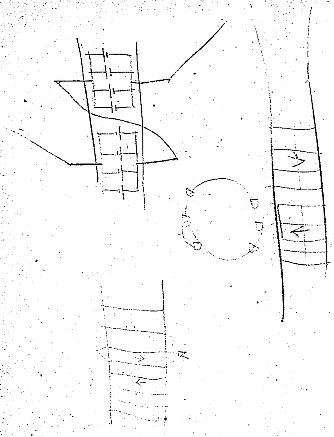

10 ohms


N
N
N
S
S
N
S

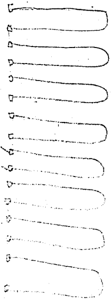


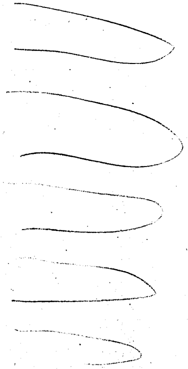


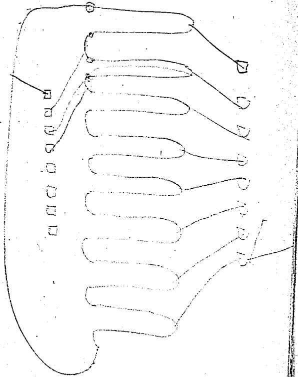


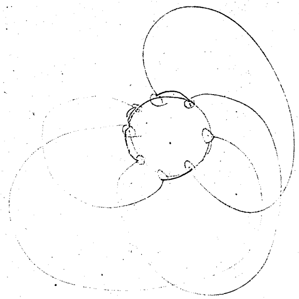


7/20 1911









9261
4
38044

10639
4
42536.

1 1/2
1 3/4 95
480

2220
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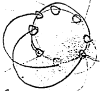
8880
384
9264
27220
36484

96
4
384

96
~~4~~
4
96
3
288



12096
4
48384

1.6744
19 1.2788
1.2788
4.2320
04
2.5) 16
10
6.40

17064

22870
20840
2030
1844
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25000
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2030
100

27220
25000
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2130
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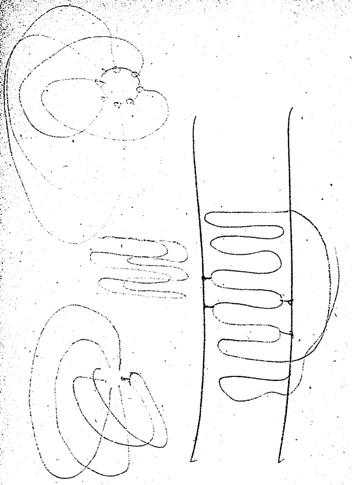
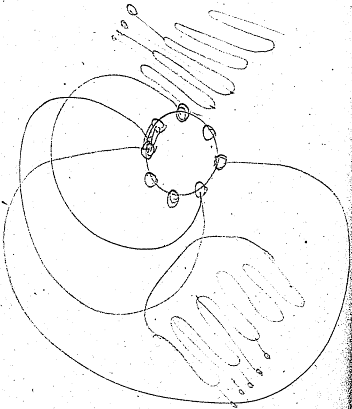
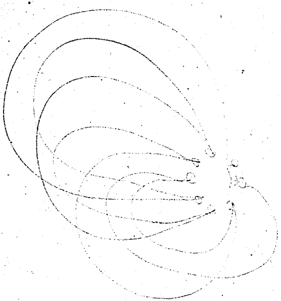
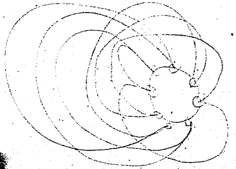
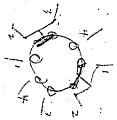
20840
18900
1940







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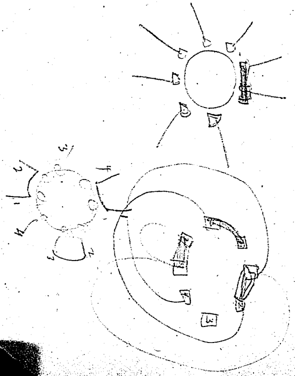
2
2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2
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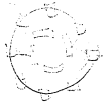

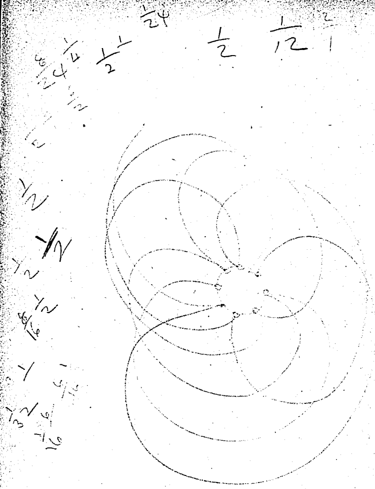
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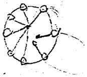
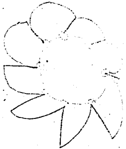
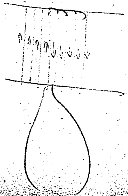
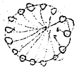
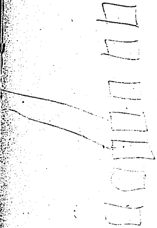
1/3
6/16
6/16

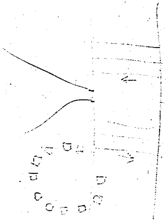


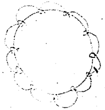


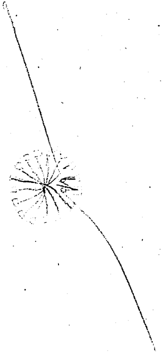


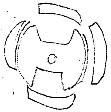


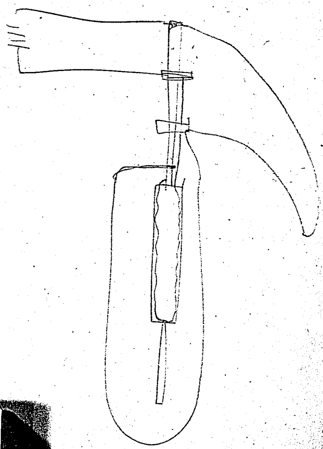








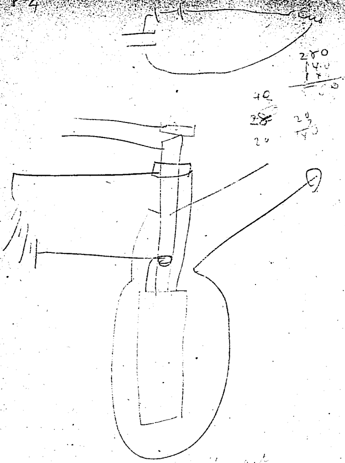




$\frac{27_2}{108} \cdot 2$ —

2104

2 8 4



280
140
140
[illegible]

40
28
20

20
140

[illegible]

876 : 124 :: 10 : ?

ft lbs .0737 = Meg Erg

10
876) 1240 (1
876

364 | 182 | 91
876 | 438 | 219

6 : X :: 212 [illegible]